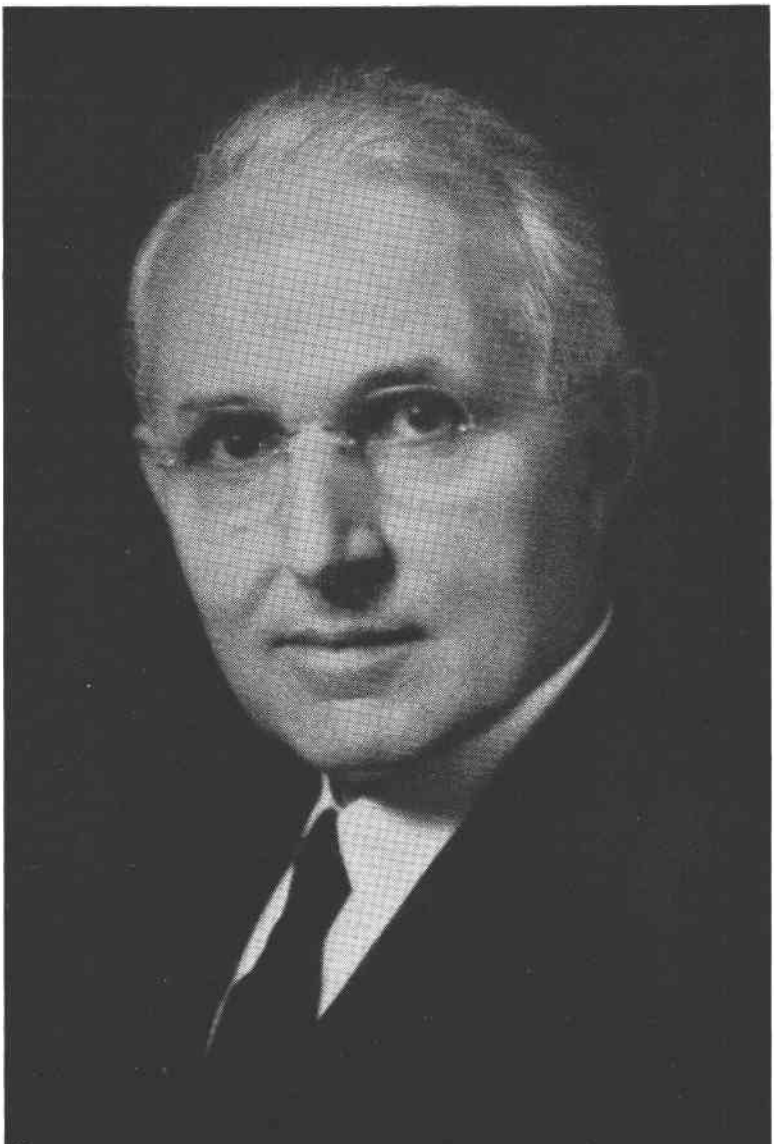
ACCEPTANCE OF THE ROEBLING MEDAL OF THE MINERALOGICAL SOCIETY OF AMERICA

EDWARD H. KRAUS,
University of Michigan, Ann Arbor, Michigan.

Today we celebrate the 25th anniversary of the founding of the Mineralogical Society of America. To be the recipient of the Roebling Medal on this occasion is indeed a signal honor. It is with sincere appreciation and with deep humility that I accept this medal presented to me on behalf of the Society by Professor Walter F. Hunt, my colleague and friend and immediate associate in the development of mineralogy at the University of Michigan during the past forty years.

At anniversay celebrations such as this, it is considered appropriate to review the accomplishments of the organization. The events that led to the founding of the Society were briefly referred to by Professor Hunt. They were, moreover, given in considerable detail in the first presidential address of the Society entitled "The Future of Mineralogy in America" which I delivered in Chicago in 1920, and at the annual meeting in 1929 the progress made by the Society during its first decade was reviewed. In 1937 at the Washington meeting, I had the honor of presenting on behalf of the Society the first Roebling Medal to Professor Charles Palache of Harvard University, the Dean of American mineralogists. Later, it was my privilege to contribute to the anniversary volume of the Geological Society of America the chapter on mineralogy in which the advances made in our science in the 50 years, 1888 to 1938, were discussed. Thus, the literature now extant covers rather adequately the general developments in mineralogy and the progress of the Mineralogical Society of America up to six years ago.

These six years have been most momentous. During this period there has been waged the greatest global struggle the world has ever experienced. Since modern warfare utilizes to the utmost the achievements of science and technology, the personnel of the country in these fields has been marshalled as never before. In fact, the urgency of war requirements compelled the crowding of a stupendous effort into this relatively brief period. This effort has wrought most significant results, which under ordinary peacetime conditions would have taken two or three times as long to accomplish. In this great effort the members of the Mineralogical Society of America have been called upon to solve in the laboratory and in the field many difficult problems which involved a comprehensive knowledge of our science. The contributions of our members have been most praise-worthy. On this occasion, I shall refer briefly to some of the services rendered.



Blackstone Studios, Inc., New York

EDWARD H. KRAUS, RECIPIENT OF THE ROEBLING MEDAL OF THE MINERALOGICAL SOCIETY OF AMERICA.

One of the most important contributions to the winning of the war, in which our mineralogists played a very important role, was made in the field of radio communication. The developments in this important field in the United States, since Pearl Harbor, are remarkable. The results which have been achieved are indeed thrilling.

As is now well known, piezoelectric oscillating crystal plates are very important for effective radio communication. As early as 1880, Jacques and Pierre Curie discovered that the crystals of those minerals and chemical substances which possess polar axes of symmetry will under favorable conditions exhibit piezoelectric properties. However, it was not until toward the close of World War I that attempts were made to apply this interesting property in developing devices for the detection of submarines.

The observation that quartz crystals, which possess this remarkable property, could be made to expand and contract rapidly when placed in an electric field, was an important discovery and led to most interesting and startling uses. In 1922, Professor W. C. Cady of Wesleyan University found that this piezoelectric property could be used to control the frequencies of oscillation of radio circuits. In due time, this led to the development of crystal-controlled radio equipment. For this purpose appropriately cut thin sections of quartz crystals proved most effective in keeping sending and receiving apparatus tuned to designated frequencies.

The preparation of piezoelectric oscillating quartz plates was at first on a rather limited and more or less custom basis. The annual output was expressed in thousands. With our entrance into the war there was immediately an urgent demand for tens of millions of such oscillating quartz plates for use in the great number of airplanes to be built, and in ships, motor vehicles, and ratio sets of all kinds. As Brazil was the principal source of suitable material and the means of shipment by sea extremely hazardous because of the submarine menace, and air transportation very limited, frantic efforts were made by mineralogists and geologists to locate other occurrences of usable quartz crystals. At the same time, it became necessary not only to accelerate the speed of production but also to make use of new crystal cuts to meet the new requirements due to the greatly varying conditions encountered in operations on the ground in widely different geographic locations and in the air at altitudes up to 30,000 feet or more.

Rapid precision methods of production had to be developed. This required the services of crystallographers and mineralogists well versed in the properties of quartz, and in applying modern optical and *x*-ray methods. No tribute is too high to be paid to our mineralogists and to the various technologists and industrial managers who quickly made possible the production of the many millions of oscillating quartz plates so urgently needed by our armed forces. This accomplishment must be included among the many miracles of science and technology this war has wrought. The various scientific aspects of oscillating quartz plates will be discussed in a series of papers by men who contributed so signally in making this miracle possible. These papers will constitute a symposium which it is hoped may be published in an early issue of *The American Mineralogist.*

We all sincerely regret that through the exigencies of the war, Dr. Harry Berman, one of our eminent and most promising younger mineralogists, made the supreme sacrifice. While on a trip to Great Britain on behalf of the furtherance of the use of piezoelectric oscillating quartz plates Dr. Berman met his tragic death in a plane crash at Prestwick, Scotland, on August 27, 1944.

Prior to the outbreak of the war, much of the industry of the United States was devoted to the production of heavy equipment such as locomotives, automobiles, trucks, agricultural equipment, refrigerators, and so forth, all of which are so essential to our modern mechanized civilization. Our industrial achievements in these areas have been remarkable. In fact, they have received great acclaim the world over.

Many of these industrial advances were, however, dependent upon the use of small items which had to be imported, for they were either not produced at all in this country, or only in very limited quantities. I refer especially to the use of diamonds and synthetic sapphires and rubies in industry. The United States was also largely dependent upon industries in the low countries, France, and Germany, for cut gem material.

The use of diamonds in industry has increased enormously in recent years. Large quantities of diamonds are now processed and used for wire drawing dies, for diamond-set tools, in the precision machining of metal and non-metal parts, and for diamond bonded wheels for sawing and abrasive purposes. When Germany overran Holland, Belgium, and France, the only supply of fine diamond wire drawing dies was cut off. These dies are necessary in the manufacture of precision wires, especially for those of smaller diameters. As these fine wires and filaments are absolutely essential in the manufacture of electrical and radio apparatus and in electric light bulbs, as well as in many other ways, a very critical situation developed. Accordingly, frantic efforts were at once made to produce these dies in this country. Unfortunately, there were very few persons in the United States with technical experience in this field, and those to whom the development of methods for the production of these dies was entrusted were not well trained in mineralogy and, hence, not familiar with the complex properties of the diamond. In addition, it was only after the lapse of a considerable period that counsel and advice was sought of those familiar with the marked variation in hardness with direction and the structural properties of the diamond. However, the progress which has been made in this field is gratifying. Industry has been supplied with sufficient quantities of domestically produced diamond dies which have given adequate service.

Another remarkable achievement during this period was the development at the Bureau of Standards in Washington of an electric drilling method for the production of super-fine dies which has recently been put into commercial use. These dies are commonly designated as triple nought dies, namely with diameters as small as 0.0003 of an inch, or 3-tenths of a mil.

With regard to diamond set tools, the United States was in a very favorable condition when hostilities broke out. Highly efficient diamond-set tools had been developed by our manufacturers. The increased demands for these tools made by the war effort were readily met by the expansion of existing plants and the development of new ones. Then too, great progress was made by manufacturers of abrasives in the production of diamond bonded wheels by using crushing boart, principally from the Belgian Congo. These wheels now play a very important role in industry and their use will undoubtedly increase materially.

The use of industrial diamonds is now very widespread. In fact, they are employed, directly or indirectly, in the manufacture of many articles in common use today. Extensive research is conducted in leading industrial countries to improve the methods of using and increasing their efficiency. To disseminate information in this important field, four years ago, the *Goldsmith's Journal* of London added a section entitled "Industrial Diamond Review." The success of this new section was immediate and the interest in its articles so great that the Review was enlarged and is now issued as an independent monthly.

As already indicated, prior to the outbreak of the war, Belgium, Holland, and Germany furnished approximately 95 per cent of the world's supply of polished diamonds. In those countries there were about 40,000 diamond cutters, as compared with only about 250 in the United States, who were mainly employed in the production of quality stones. When Germany overran the low countries, our main sources of these diamonds were cut off. Efforts were then made to increase the output of polished diamonds in this country, and quantity production methods were introduced, especially for the cutting of stones of smaller sizes. As a result, the number of cutters and apprentices in this country increased rapidly for many new shops were opened.

The question is often asked whether the cutters of the United States will be able to compete successfully with those of the European countries after hostilities cease. According to current opinion, it is firmly believed that quality cutting of stones of the larger sizes in this country will continue to be profitable so long as rough material can be imported duty free and polished diamonds are subject to a 10 per cent duty. Because of the great difference in labor costs, quantity cutting of the smaller sizes, especially those known as melee, will undoubtedly encounter very strong competition from the European countries. Thus, the future of this phase of the diamond cutting industry is quite problematical.

In the manufacture of watches, chronometers, precision scientific instruments, electrical meters, and so forth, small hard bearing parts, commonly known as jewels, are extremely essential. Experience over many years has shown that jewels made of the varieties of corundum, aluminum oxide, known as sapphire and ruby, are extremely efficient. At first, natural sapphires and rubies were used in the manufacture of these jewels and bearing parts, but as their supply is limited, most of the jewels are now made from synthetic material.

The method of producing synthetic sapphires and rubies, which is now in use, was first introduced about 1902. It has since been greatly improved and at present synthetic material of high quality is available which is used to manufacture large quantities of jewels. Prior to the war all of these jewels were imported from abroad, principally from Switzerland, France, and Germany, for there were no plants in this country. As soon as hostilities broke out, we were threatened with a very critical shortage. This was due not only to the supply from abroad being greatly reduced but also because the war effort entailed the production of enormous quantities of matériel in which these jewels are most essential. Immediately, efforts were made to have synthetic sapphires and rubies produced in this country so that an adequate supply of rough material might be available for the fabrication of these greatly needed jewels.

But very few of our mineralogists had paid any attention whatever to the production of synthetic gem materials, and hence the source of information was very limited. Fortunately, at the University of Michigan, this phase of the gem industry had long been stressed. On several occasions I had the opportunity of visiting plants in Switzerland and Germany where synthetic rubies and sapphires were produced and fabricated into jewels. We were, therefore, able to furnish reliable information to the representatives of the Linde Air Products Company, Incorporated, which contemplated entering this field and is now the largest producer in this country of boules of this greatly needed synthetic product. As it was impossible to locate any refugee, who had had practical experience in one of the European plants, it was necessary for the firm to start from the beginning. Here, too, the contributions made by the various mineralogists, chemists, and physicists, who were called into consultation, have been noteworthy. Aided by these contributions, the very able research and technological staffs of the Company have wrought another miracle of production. Not only have the requirements for rough material been adequately met, but new methods of production have been developed which should prove very helpful in meeting foreign competition when the trade routes of the world are again open. It should also be noted that there are now several companies in this country fabricating the domestically produced material into jewels and bearing parts of high quality. At the present time the boules of synthetic sapphire and ruby are used primarily to meet the demands of industry, but it is expected that in due time this product will also be used for cutting and polishing stones into gems.

One of the great imperatives of the war effort has been the need to greatly expand our supplies of various strategic minerals. In the search for new occurrences of these minerals, which might prove of economic importance, the members of our Society cooperated enthusiastically. The list of those who have been or still are participating in these projects is a long one.

One of the most helpful developments in recent years, which has been greatly augmented by the war, is the pooling of information and thought by scientists in border-line fields. This has been notably true in the application of *x*-ray methods in the study of crystal structure. Crystallographers, mineralogists, physicists, chemists, and mathematicians are all involved in problems in this area of science. Several years ago it was deemed desirable that workers in these sciences, who are interested in crystal structure, should have the opportunity of meeting together and discussing their mutual problems. For this purpose, the American Society for *X*-ray and Electron Diffraction was organized in 1941. It is indeed gratifying that many fellows and members of the Mineralogical Society of America have been very active in this new organization and that one of our fellows was elected as its first President and served two consecutive terms. Members of this new society have already made many important contributions by solving some very complex problems through the concerted action of experts in several cognate fields.

From the very beginning, through its annual meetings and *The American Mineralogist*, our Society has been very successful in the furtherance of the several sciences represented by its membership. This is most gratifying. It should also be noted that during the last two decades the general public has shown greatly increased interest in things mineralogical. This has resulted in the organization throughout the country of many local and regional mineralogical clubs and societies composed largely of persons who are lovers of minerals and who desire authoritative information concerning their properties, identification, uses, and methods of occurrence and display. To aid in disseminating such information some of these organizations have established their own journals. These organizations have also stimulated interest in the art of cutting and polishing minerals for gem purposes. There are now many amateur lapidaries as well as an increased number of professional shops well equipped with modern apparatus. These shops have done much to relieve the shortage in the supply of semiprecious cut material caused by the war.

Another advance of recent years, which should be more widely recognized by professional mineralogists and geologists, is that made by progressive retailers of gems and gem materials. It was not so long ago that members of the most reliable firms of jewelers in our larger communities were not well informed concerning the properties and characteristics of the gem materials they sold, and therefore were often unable to answer intelligently many pertinent questions asked by inquiring prospective purchasers. But today, the situation is greatly changed largely due to the activities of the Gemological Society of America and the Gemological Institute, in which some of the members of our Society have been active. At present, there are retail stores in many communities with personnel well informed on the scientific aspects of gems and well supplied with instruments, such as,—refractometers, dichroscopes, specific gravity balances, diamondscopes, and sometimes even with polarizing microscopes,—which are essential for the accurate determination of physical and optical properties. It is now possible to ask questions relating to specific gravity, hardness, index of refraction, dichroism, optical character—as to whether the stone is isotropic or anisotropic, uniaxial or biaxial, positive or negative,—and receive intelligent answers. This is extremely gratifying to those of us who for many years have labored consistently to disseminate authoritative information in this important branch of mineralogy.

Twenty-five years ago the future of the Mineralogical Society of America was considered by many as being highly problematical. This opinion was held largely by those who were not closely identified with our subject. But soon a more favorable opinion developed, due in the main to the rapid increase in the number of fellows and members and the development of *The American Mineralogist*, as a leading scientific journal. In addition, the Roebling gift of $45,000 in 1926, and the excellent cooperation of the Geological Society of America from the beginning as well as its financial support in recent years, have aided the Society greatly in attaining its high position among similar organizations in this field.

The concluding paragraph of my review of the progress made by the Society during its first ten years may well be repeated now, with only two slight changes. "While today we rejoice that the achievements of the Society have been so significant during the first *twenty-five* years, we are at the same time confident that the next *quarter of a century* will show equal or even greater accomplishments. This will be readily possible if we maintain the same enthusiastic interest in the science and the splendid loyalty and spirit of co-operation that have been so marked since our organization."